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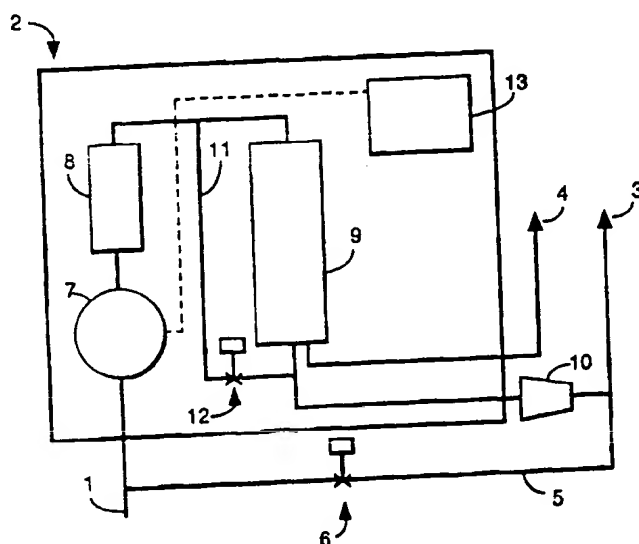
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : E03D 5/00		A1	(11) International Publication Number: WO 97/03254 (43) International Publication Date: 30 January 1997 (30.01.97)
(21) International Application Number: PCT/GB96/01637 (22) International Filing Date: 8 July 1996 (08.07.96) (30) Priority Data: 9514281.6 13 July 1995 (13.07.95) GB (71) Applicant (for all designated States except US): ANGLIAN WATER SERVICES LTD. [GB/GB]; Anglian House, Ambury Road, Huntingdon, Cambridgeshire PE18 6NZ (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): MURRER, Edwin, William, John [GB/GB]; 24 West Drive, Highfields, Caldecote, Cambridge CB3 7NY (GB). (74) Agent: GILL JENNINGS & EVERY; Broadgate House, 7 Eldon Street, London EC2M 7LH (GB).		(81) Designated States: AL, AM, AU, AZ, BB, BG, BR, BY, CA, CN, CZ, EE, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, RO, RU, SD, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  Published With international search report.	

(54) Title: DOMESTIC WATER TREATMENT SYSTEM



(57) Abstract

A domestic water system comprises: units, including toilets, fed under gravity from a storage tank; a water softener (2) including a membrane (9), and first and second outlets (3, 4) for softened water and reject water, respectively and first and second storage tanks (14, 15) for softened water and reject water, respectively, the second tank (15) being in connection with the toilet (24), and the first tank (14) being in connection with other units (20). The invention makes particular use of the fact that the proportion of reject water from a membrane softener, and the proportion of domestic water usage for flushing toilets, are very similar. Water wastage is thus minimised.

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DOMESTIC WATER TREATMENT SYSTEMField of the Invention

This invention relates to a domestic water treatment system. It relates in particular to a system adapted to  
5 maximise the use of softened water, and to minimise water wastage.

Background of the Invention

The most common form of domestic water softener is an ion-exchange system, in which the hardness is removed by  
10 deposition onto special resin beads. At frequent intervals, the resin beads need to be cleaned; a salt solution is used to regenerate the resin by removing the hardness which then forms part of a salt/hardness waste stream. The waste stream is discharged to the sewer. This  
15 type of softening device will produce water of variable hardness, depending upon the condition of the resin beads. Typically, this type of water softener treats all the water on its way to the storage tank in the loft, and of this total volume about 35% will be used for flushing toilets.

20 Membranes are very effective at softening water. They do not need any form of regeneration but do produce a reject stream which can be as high as 50% of the volume treated. Direct disposal of the reject system would be a waste of water and cause very high water consumption.

25 EP-A-0393308 describes apparatus for washing vehicles, using a membrane separator through which water is pumped and divided into two streams, a clean water stream and a reject water stream. The streams pass to respective storage tanks, from which water is taken as desired, the  
30 reject water for washing vehicles and the clean water for rinsing them. The level of reject water is controlled and, if it falls, the clean water is used to supplement the reject water. Part of the reject stream is recirculated to the inlet of the membrane separator, via the pump.

35 WPI Abstract Accession No. 75-65172W/39 (SU-A-0454180) discloses splitting the output from a cation-exchange membrane separator. One output is used to feed boilers,

and the other to maintain water levels. The outputs may also be mixed.

#### Summary of the Invention

It has now been appreciated that membranes, particularly those that have been recently developed for use under low pressures, can increase the output from a small membrane softening unit. At the same time, the re-use of the reject stream for toilet flushing ensures that no water is lost, and that toilets are not flushed with expensive softened water.

According to the present invention, in a domestic water system having units, including toilets, fed under gravity from a storage tank, the system comprises:

a water softener including a membrane, and first and second outlets for softened water and reject water, respectively;

first and second storage tanks for softened water and reject water, respectively, the second tank being in connection with toilets, and the first tank being in connection with other units.

#### Brief Description of the Drawings

The invention will be described by way of example only with reference to the accompanying drawings, in which:

Figs. 1A and 1B are each highly schematic views of units that, in combination, constitute a preferred embodiment of a domestic water system according to this invention.

#### Description of the Invention

In general terms, the system to which this invention relates incorporates a domestic membrane water softener as part of an installation which enables the re-use of the reject stream for toilet flushing. For example, an embodiment of this invention utilises a unit that comprises a small pump, a carbon filter and the membrane which is installed in a small pressure tube. The membrane unit may be controlled by a small panel which is programmable to operate mainly at night using cheap rate electricity, with

top-ups during the day as required. An automatic by-pass conduit may be provided, with a valve programmed to valve open when the unit is out of action. This ensures that at least the reject water storage tank is supplied with sufficient, mains water.

The softened water stream from the membrane is piped to a storage tank in the loft. As in a conventional domestic system, this water is used to supply domestic units, e.g. handbasins and/or baths, under gravity. A conventional valve may be provided, to control the maximum level of water in this tank.

The reject stream from the membrane is piped to a second storage tank in the loft. This is used as the supply to the toilet cisterns. The reject water storage tank is connected to the mains feed via a low level ball valve, to ensure a supply at times when the membrane unit switched off. In case the level rises, an overflow is provided.

It is a particular advantage of the present invention that the reject stream typically constitutes about 40%, e.g. within the range of 30-50%, of the input, and that this is comparable to the amount of water conventionally used for flushing toilets. The amount of water lost via the overflow is therefore low. Thus, a system of the invention is well adapted to maximum usage of water, on the one hand of "clean water" that users of units such as baths and/or handbasins can happily allow to come into contact with the body, and on the other hand of "grey" water which cannot be used for the same purpose but which can usefully be used in a domestic environment. This is distinct from any possible reuse of grey water from, say, handbasins.

In the drawings, Fig. 1A shows an inlet 1 from a mains water supply (not shown), a membrane softening unit indicated generally at 2, and outlets 3,4 for softened water and reject water, respectively. In addition, a conduit 5 including an automatic by-pass valve 6 provides

an alternative route for water from the inlet 1 to the outlet 3.

The unit 2 comprises, in line, a pump 7, a carbon filter 8, a membrane in a pressure tube 9, and a non-return valve 10 on the softened water outlet. In addition, an internal by-pass conduit 11 includes a blend control valve 12. This valve and the pump, and also the valve 6, are controlled, and the control is supplied with power, by means (not shown); a control panel 13 is provided.

As indicated above, the unit is programmable to run when required, e.g. using cheap-rate electricity. When not in use, the valve 6 is opened, so that mains water passes directly to the outlet 3.

Fig. 18 shows storage tanks 14 and 15, provided in a domestic loft, respectively for softened water and reject water, supplied by inlets 16 and 17 corresponding to the softening unit's outlets 3 and 4. The storage tank 14 has a conventional ball valve 18, and an outlet 19 leading to, say, baths and handbasins; a handbasin 20 is shown.

The reject water storage tank 15 is supplied additionally by a mains water inlet 21. A conventional low level ball valve 22 ensures that the water level does not fall below a minimum. An outlet 23 leads to toilets, one of which is shown at 24. There is also an overflow 25, leading directly to the sewer.

CLAIMS

1. A domestic water system comprising:  
units, including toilets, fed under gravity from a  
storage tank;  
5 a water softener including a membrane, and first and  
second outlets for softened water and reject water,  
respectively; and  
first and second storage tanks for softened water and  
reject water, respectively, the second tank being in  
10 connection with the toilet, and the first tank being in  
connection with other units.
2. A system according to claim 1, which additionally  
comprises means for controlling operation of the softener,  
and a by-pass conduit for water to at least the first  
15 outlet, the conduit being open when the water softener is  
turned off.
3. A system according to claim 1, which additionally  
comprises a valve controlling the maximum level of water in  
the first tank, an inlet for mains water into the second  
20 tank, a valve controlling the minimum water level in the  
second tank, and an overflow from the second tank.
4. A system according to claim 1, wherein said other  
units comprise handbasins and/or baths.

Fig.1A.

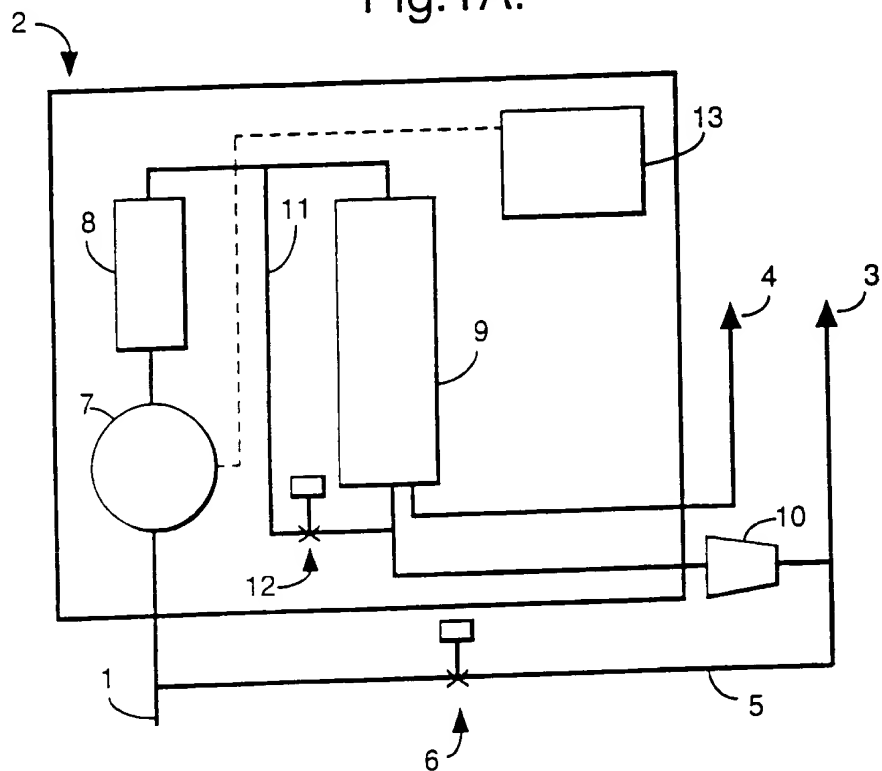
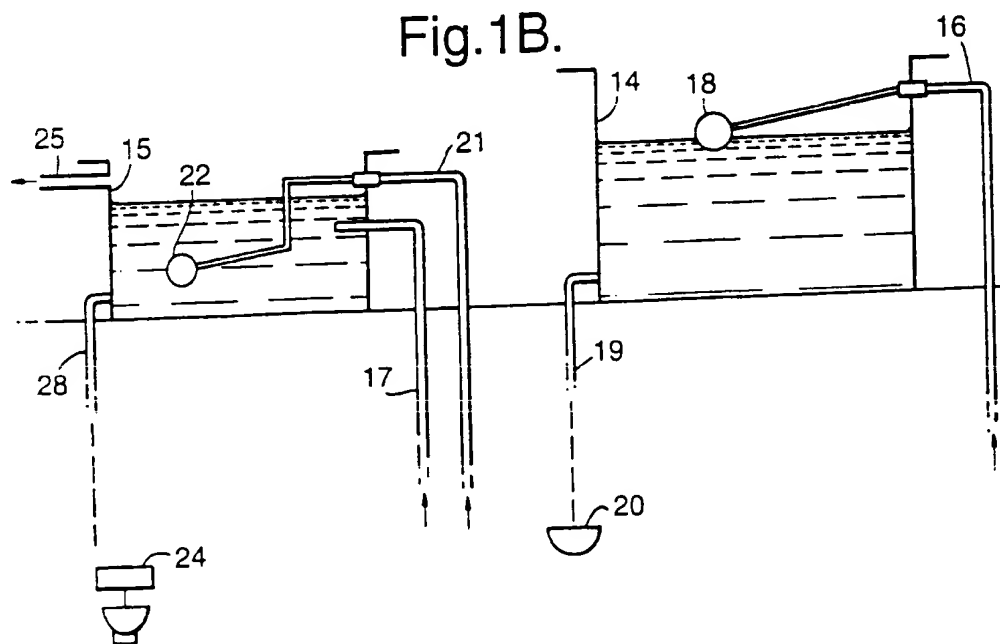


Fig.1B.





# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/GB 96/01637

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 E03D5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 E03D E03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 616 976 (GRUENBECK JOSEF WASSERAUF) 28 September 1994 see column 1, line 24 - column 2, line 31; figure	1,4
Y	DE,A,37 38 231 (BLANCO GMBH & CO KG) 24 May 1989 see column 3, line 33 - line 47 see column 4, line 8 - line 14 see figure 1	1,4
A	DE,A,40 07 351 (BROEKE ERNST H) 10 January 1991 see column 4, line 22 - column 6, line 3 see figures	1
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☒ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

18 October 1996

Date of mailing of the international search report

08. 11 96

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## C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 393 308 (SOGICO SA) 24 October 1990 cited in the application see the whole document ---	1
A	DE,A,43 35 669 (BWT WASSERTECHNIK GMBH) 27 April 1995 -----	

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Information on patent family members

Int. Application No.

PCT/GB 96/01637

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DE-A-4007351	10-01-91	DE-A- 3904452 DE-A- 3927346	18-10-90 28-02-91
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DE-A-4335669	27-04-95	NONE	